3GPP SA5 intent-driven management for mobile network

December 10th,2024

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Overview of 3GPP work on intent driven management

3GPP SA5 start the intent driven management work since June 2018.

- **Release 17**
  - TR 28.812 Telecommunication management; Study on scenarios for Intent driven management services for mobile networks**.**
    Published in Sep 2020.
  - TS 28.312 (R17) Management and orchestration; Intent driven management services for mobile networks.
    Published in June 2022.
- **Release 18**
  - TR 28.912 Study on enhanced intent driven management services for mobile networks**.**
    Published in June 2023.
  - TS 28.312 (R18) Management and orchestration; Intent driven management services for mobile networks.
    Published in December 2023.
- **Release 19**
  - TR 28.914 Study on intent driven management service for mobile network phase 3**.**
    Published in December 2024.
  - TS 28.312 (R19) Management and orchestration; Intent driven management services for mobile networks.
    Target date: June 2025.

Key outcomes from R17 and R18 intent driven management WI (TS 28.312)

3GPP Intent definition and concept

◆ Intent Definition:

Intent: expectations including requirements, goals and constraints given to a 3GPP system, without specifying how to achieve them.

◆ General Concept of Intent:

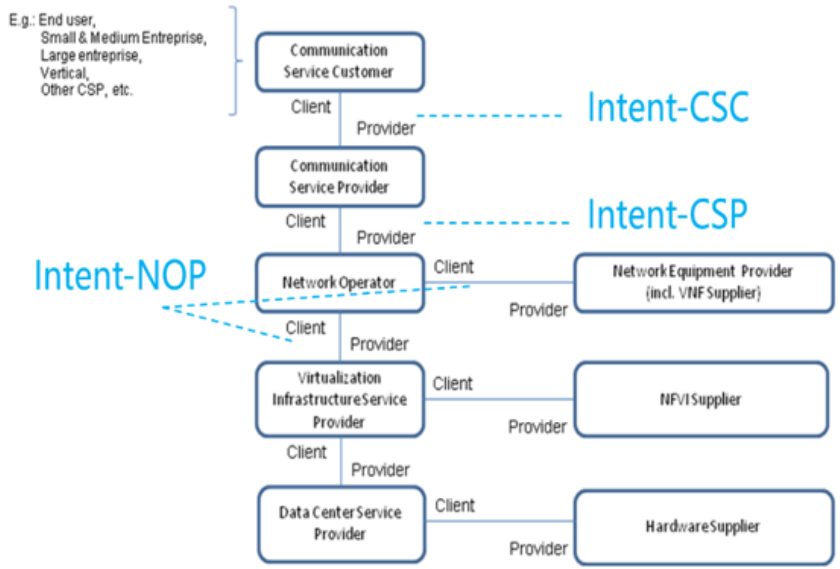
- ◆ An intent is typically understandable by humans, and also needs to be interpreted by a machine without any ambiguity.
- ◆ An intent focuses more on describing the "What" needs to be achieved and less on "How" the outcomes should be achieved…
- ◆ The expectations expressed by an intent are agnostic to the underlying system implementation, technology and infrastructure…
- ◆ An intent needs to be quantifiable from network data so that the fulfilment result can be measured and evaluated.

3GPP Intent categories

◆ Intent categories based on user types:

Based on roles related to 5G networks and network slicing management, different kinds of intents are applicable for different kinds of standardized reference interfaces.

- **Intent from Communication Service Customer (Intent-CSC)**: Intent from Communication Service Customer enables Communication Service Customer (CSC) to express which properties of a communication service the CSC may request from CSP without knowing how to do the detailed management for communication service. For example, Intent-CSC can be 'Enable a V2X communication service for a group of vehicles in certain time'.
- **Intent from Communication Service Provider (Intent-CSP)**: Intent from Communication Service Provider enables Communication Service Provider (CSP) to express an intent about what CSP would like to do for network without knowing how to do the detailed management for network. For example, Intent-CSP can be 'Provide a network service supporting V2X communications for Highway-417 to support 500 vehicles simultaneously'.
- **Intent from Network Operator (Intent-NOP):** Intent from Network Operator enables Network Operator (NOP) to provide what NOP would like to do for group of network elements (i.e. subnetwork) management and control without knowing how to do the detailed management for the network elements. For example, Intent-NOP can be 'Provide a radio network service to satisfy the specified coverage requirements and UE throughput requirement in certain area'.



3GPP Intent driven management scenarios

- **Scenario specific intent driven management use cases**

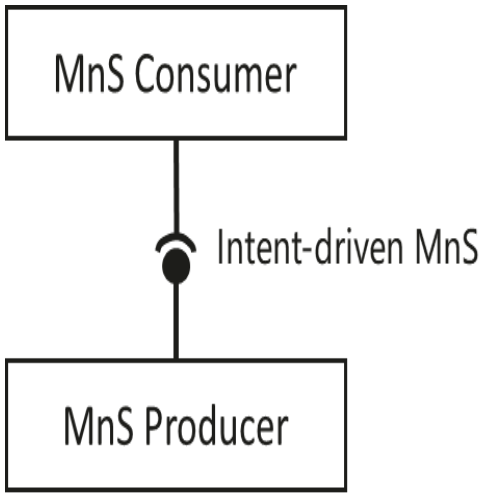
✓ Intent containing an expectation for delivering radio network
✓ Intent containing an expectation for delivering a radio service
✓ Intent containing an expectation for delivering a service at the edge
✓ Intent containing an expectation on coverage performance to be assured
✓ Intent containing an expectation on radio network performance to be assured
✓ Intent containing an expectation for end-to-end network optimization
✓ Intent containing an expectation for RAN energy saving
✓ Intent containing an expectation for 5GC network

3GPP Intent driven management service

◆ Concept of Intent driven management service

The intent driven MnS solution specified by is a simplified and flexible interface, which allows for extensions to support any new scenarios/services. The intent driven MnS solution uses the “model driven approach” in SBMA, which decouples the operations from the intent model. In the solution in the following are defined:

- ✓ A unified set of management operations and an intent information model (with both information model and data model defined) to support intent lifecycle management. Therein, an intent is a set of intent expectations, each containing a set of expectation targets with optional contexts possible for each expectation target, intent expectation or the intent itself.
- ✓ Intent Expectation instances (Including RadioNetworkExpectation, Edge Service Support Expectation, End-to-end Network Resource Optimization Expectation, 5GC Network Expectation and Radio Service Expectation) to support the typical intent driven scenarios.



3GPP Intent driven MnS definition

◆ Management operations

✓ Intent lifecycle management

intent lifecycle management	IS operation	HTTP Method	Resource URI
Create an intent	createMOI operation	PUT	{MnSRoot}/ProvMnS/{MnSVersion}/{URI-LDN-first-part}/{intent}={id}
Delete an intent	deleteMOI operation	DELETE	{MnSRoot}/ProvMnS/{MnSVersion}/{URI-LDN-first-part}/{intent}={id}
Modify an intent	modifyMOIAttributes operation	PUT PATCH	{MnSRoot}/ProvMnS/{MnSVersion}/{URI-LDN-first-part}/{intent}={id}
Query an intent	getMOIAttributes operation	GET	{MnSRoot}/ProvMnS/{MnSVersion}/{URI-LDN-first-part}/{intent}={id}
Activate an intent	modifyMOIAttributes operation	PUT PATCH	{MnSRoot}/ProvMnS/{MnSVersion}/{URI-LDN-first-part}/{intent}={id}
Deactivate an intent	modifyMOIAttributes operation	PUT PATCH	{MnSRoot}/ProvMnS/{MnSVersion}/{URI-LDN-first-part}/{intent}={id}

✓ Intent report management

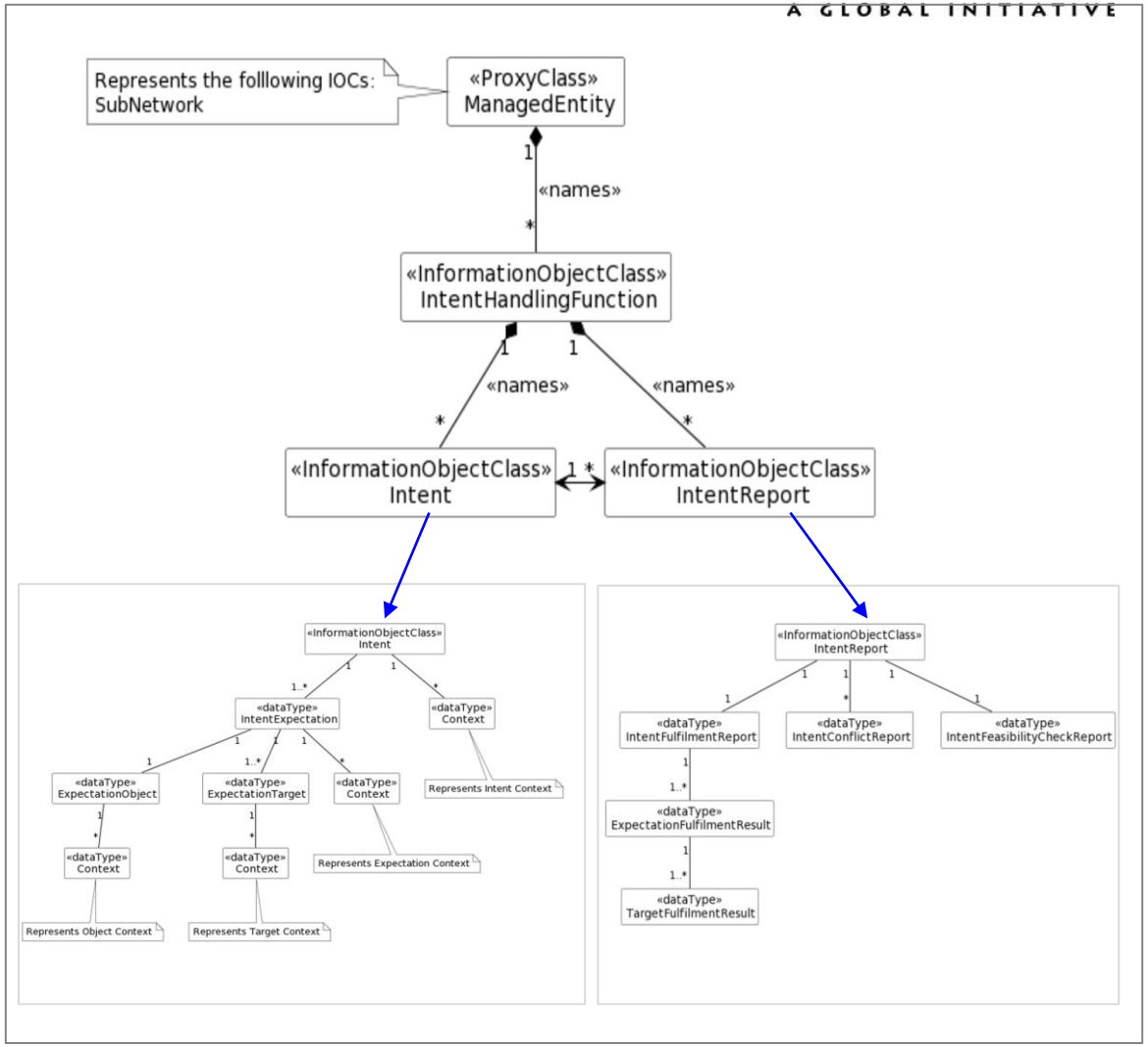
intent report management	IS operation	HTTP Method	Resource URI
Query an intent report	getMOIAttributes operation	GET	{MnSRoot}/ProvMnS/{MnSVersion}/{URI-LDN-first-part}/{intentReport}={id}
Subscribe an intent report	createMOI operation	PUT	{MnSRoot}/ProvMnS/{MnSVersion}/{URI-LDN-first-part}/{NtfSubscriptionControl }={id}
Notify an intent report	notifyMOIAttributeValueChanges notification	POST	{notificationTarget}
Unsubscribe an intent report	deleteMOI operation	DELETE	{MnSRoot}/ProvMnS/{MnSVersion}/{URI-LDN-first-part}/{NtfSubscriptionControl }={id}
Query an intent report subscription	getMOIAttributes operation	GET	{MnSRoot}/ProvMnS/{MnSVersion}/{URI-LDN-first-part}/{NtfSubscriptionControl }={id}

✓ Intent handling capability obtaining

intent report management	IS operation	HTTP Method	Resource URI
Query intent handling capability	getMOIAttributes operation	GET	{MnSRoot}/ProvMnS/{MnSVersion}/{URI-LDN-first-part}/{intentHandlingFunction}={id}

OpenAPI: https://forge.3gpp.org/rep/sa5/MnS/-/blob/Rel-18/OpenAPI/TS28532_ProvMnS.yaml

◆ Information model



OpenAPI: https://forge.3gpp.org/rep/sa5/MnS/-/blob/Rel-18/OpenAPI/TS28312_IntentNrm.yaml

3GPP Scenario specific IntentExpectation

- **Scenario specific intent expectation:** RadioNetworkExpectation, Edge Service Support Expectation, End-to-end Network Resource Optimization Expectation, 5GC Network Expectation and Radio Service Expectation. Following use the Radio Network Expectation as example

RadioNetworkExpectation

Following are the specific allowed values when implemented the IntentExpectation for Radio Network Expectation.

Table 6.2.2.1.1.1-1

Attribute Name	Allowed Values
objectType (CM)	RAN SubNetwork
objectInstance (CM)	DN of the RAN SubNetwork

- 6.2.2.1.1.2 → ObjectContexts

Following provides the concrete ObjectContexts for Radio Network Expectation based on the common structure of ObjectContext. The properties of the attributes in the following table should be same with properties of ObjectContexts defined in clause 6.2.1.3. The usage of following contexts for corresponding use cases see Table 8.1 Guidelines for using scenario specific intent expectation for intent driven use cases.

Table 6.2.2.1.1.2-1

Attribute Name	Support Qualifier	isReadable	isWritable	isInvariant	isNotifyable
coverageAreaPolygonContext	O	T	T	F	F
coverageTACContext	O	T	T	F	F
pLMNContext	O	T	T	F	F
dlFrequencyContext	O	T	T	F	F
ulFrequencyContext	O	T	T	F	F
rATContext	O	T	T	F	F
uEGroupContext	O	T	T	F	F

- 6.2.2.1.1.3 → ExpectationTargets

Following provides the concrete ExpectationTargets for Radio Network Expectation based on the common structure of ExpectationTarget. The properties of the attributes in the following table should be the same with properties of ExpectationTargets defined in clause 6.2.1.3. The usage of following targets for corresponding use cases see Table 8.1 Guidelines for using scenario specific intent expectation for intent driven use cases.

Table 6.2.2.1.1.3-1

Attribute Name	Support Qualifier	isReadable	isWritable	isInvariant	isNotifyable
weakRSRPRatioTarget	O	T	T	F	F
lowSINRRatioTarget	O	T	T	F	F
aveULRANUEThptTarget	O	T	T	F	F
aveDLRANUEthptTarget	O	T	T	F	F
lowULRANUEThptRatioTarget	O	T	T	F	F
lowDLRANUEThptRatioTarget	O	T	T	F	F
highUlPrbLoadRatioTarget	O	T	T	F	F
highDlPrbLoadRatioTarget	O	T	T	F	F
aveUlPrbLoadTarget	O	T	T	F	F
aveDlPrbLoadTarget	O	T	T	F	F
rANEnergyConsumptionTarget	O	T	T	F	F
rANEnergyEfficiencyTarget	O	T	T	F	F

- 6.2.2.1.1.4 → ExpectationContexts

Following provides the concrete ExpectationContexts for Radio Network Expectation based on the common structure of ExpectationContext. The attribute properties defined in the table below should be the same as the properties defined for ExpectationContexts in clause 6.2.1.3.

Attribute Name	Support Qualifier	isReadable	isWritable	isInvariant	isNotifyable
targetAssuranceTimeContext	O	T	F	F	F

Guidelines for using RadioNetworkExpectation for intent driven use cases

Use case	Scenario specific IntentExpectation	ExpectationObject. ObjectContext	ExpectationTarget
Intent containing an expectation for delivering radio network (clause 5.1.1)	Radio Network Expectation	- coverageAreaPolygonContext - coverageTACContext - pLMNContext - dlFrequencyContext - ulFrequencyContext - rATContext	-weakRSRPRatioTarget - lowSINRRatioTarget - aveULRANUEThptTarget - aveDLRANUEthptTarget
Intent containing an expectation on coverage performance to be assured (clause 5.1.4)	Radio Network Expectation	- coverageAreaPolygonContext - dlFrequencyContext - ulFrequencyContext - rATContext	-weakRSRPRatioTarget -lowSINRRatioTarget
Intent containing an expectation on RAN UE throughput performance to be assured (clause 5.1.5)	Radio Network Expectation	- coverageAreaPolygonContext - dlFrequencyContext - ulFrequencyContext - rATContext - uEGroupContext	- aveULRANUEThptTarget - aveDLRANUEthptTarget - lowULRANUEThptRatioTarget - lowDLRANUEThptRatioTarget
Intent containing an expectation on RAN capacity performance to be assured (clause 5.1.5)	Radio Network Expectation	- coverageAreaPolygonContext - dlFrequencyContext - ulFrequencyContext - rATContext	- highUlPrbLoadRatioTarget - highDlPrbLoadRatioTarget - aveUlPrbLoadTarget - aveDlPrbLoadTarget
Intent containing an expectation on RAN energy saving (clause 5.1.7)	Radio Network Expectation	- coverageAreaPolygonContext - pLMNContext - dlFrequencyContext - ulFrequencyContext - rATContext	- rANEnergyConsumptionTarget -rANEnergyEfficiencyTarget - aveULRANUEThptTarget - aveDLRANUEThptTarget

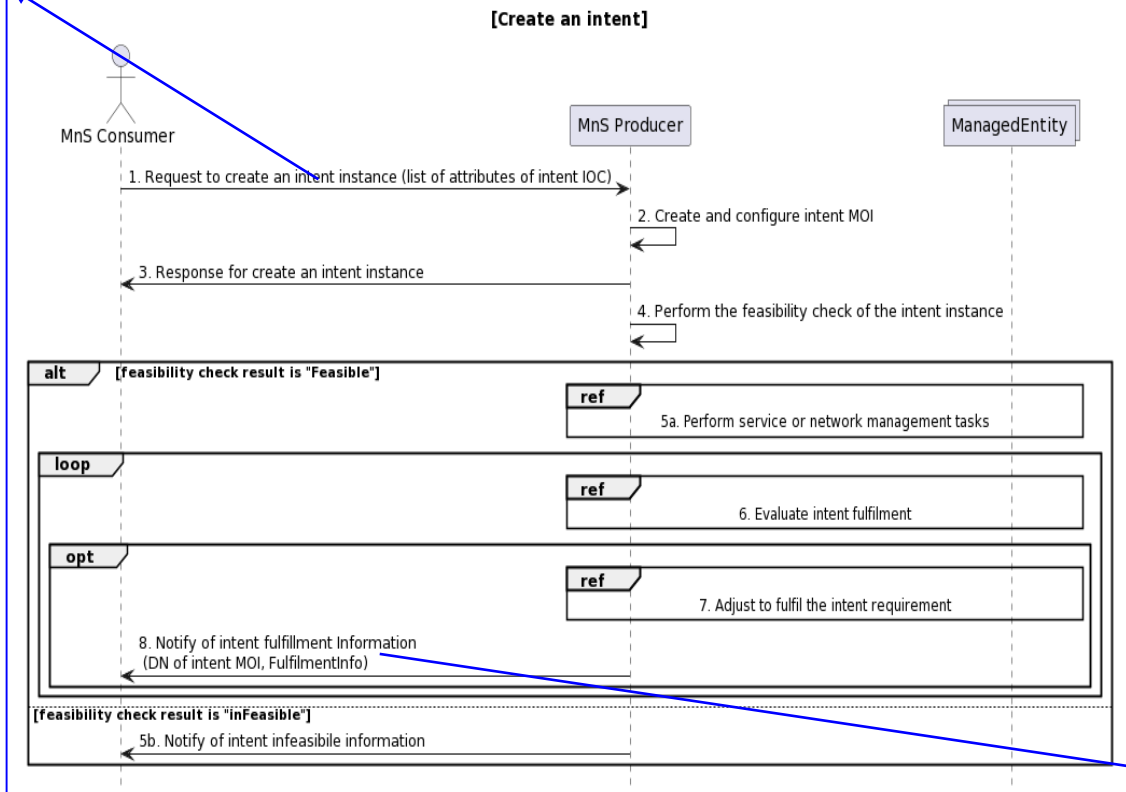
OpenAPI: https://forge.3gpp.org/rep/sa5/MnS/-/blob/Rel-18/OpenAPI/TS28312_IntentExpectations.yaml

Workflow example of creating RAN Energy Saving Intent

Implemented by createMOI operation +RAN energy saving Intent

- YAML document Example for example for Intent containing an expectation on RAN energy saving

```
Intent:
  Id: 'Intent_5'
  userLabel: 'RAN_Energy_Saving'
  intentExpectation:
    - expectationId: '1'
      expectationVerb: 'Ensure'
      expectationObjects:
        - objectInstance: 'SubNetwork_1'
          objectContexts:
            - contextAttribute: 'CoverageAreaPolygon'
              contextCondition: 'IS_ALL_OF'
              contextValueRange:
                - convexGeoPolygon:
                    - latitude: '31.2696'
                      longitude: '121.6322'
                    - latitude: '31.2668'
                      longitude: '121.6323'
                    - latitude: '31.2669'
                      longitude: '121.6412'
                    - latitude: '31.2696'
                      longitude: '121.6410'
            - contextAttribute: 'PLMN'
              contextCondition: 'IS_ALL_OF'
              contextValueRange:
                - '46000'
            - contextAttribute: 'DlFrequency'
              contextCondition: 'IS_ALL_OF'
              contextValueRange:
                - arfcn: '384000'
            - contextAttribute: 'RAT'
              contextCondition: 'IS_ALL_OF'
              contextValueRange:
                - 'NR'
            - contextAttribute: 'TargetAssuranceTime'
              contextCondition: 'IS_EQUAL_TO'
              contextValueRange:
                - startTime: '2023-10-27-22-00-00'
                  endTime: '2023-10-28-06-00-00'
      expectationTargets:
        - targetName: 'RANEnergyConsumption'
          targetCondition: 'IS_LESS_THAN'
          targetValueRange: '1000'
        - targetName: 'RANEnergyEfficiency'
          targetCondition: 'IS_GREATER_THAN'
          targetValueRange: '400000'
        - targetName: 'AveULRANUEThpt'
          targetCondition: 'IS_GREATER_THAN'
          targetValueRange: '100'
        - targetName: 'AveDLRANUEThpt'
          targetCondition: 'IS_GREATER_THAN'
          targetValueRange: '300'
  intentPriority: '6'
  observationPeriod: '60'
  intentReportReference: 'IntentReport_5'
```

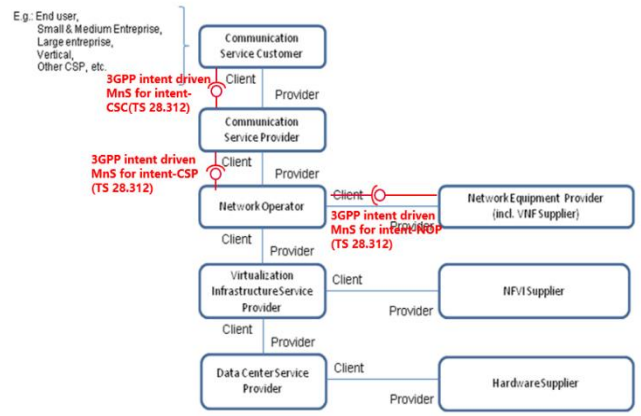


Implemented by notifyMOIAttributeValueChanges + IntentReport instance

```
IntentReport:
  id: 'RAN_Energy_Saving_Report'
  intentFulfilmentReport:
    intentFulfilmentInfo:
      fulfilmentStatus: 'NOTFULFILLED'
      notFulfilledState: 'SUSPENDED'
      notFulfilledReasons:
        - 'Target_conflict_detected'
    expectationFulfilmentResults:
      - expectationId: '1'
        expectationFulfilmentInfo:
          fulfilmentStatus: 'NOTFULFILLED'
        targetFulfilmentResults:
          - targetName: 'RANEnergyConsumption'
            targetFulfilmentInfo:
              fulfilmentStatus: 'FULFILLED'
              targetAchievedValue: '900'
          - targetName: 'RANEnergyEfficiencyTarget'
            targetFulfilmentInfo:
              fulfilmentStatus: 'FULFILLED'
              targetAchievedValue: '410000'
          - targetName: 'AveULRANUEThpt'
            targetFulfilmentInfo:
              fulfilmentStatus: 'FULFILLED'
              targetAchievedValue: '100'
          - targetName: 'AveDLRANUEThpt'
            targetFulfilmentInfo:
              fulfilmentStatus: 'NOTFULFILLED'
              targetAchievedValue: '200'
  intentConflictReports:
    - conflictType: 'TARGET_CONFLICT'
      conflictingTarget: 'RANEnergyConsumption'
      recommendedSolutions: 'MODIFY'
    - conflictType: 'TARGET_CONFLICT'
      conflictingTarget: 'AveDLRANUEThpt'
      recommendedSolutions: 'MODIFY'
  intentFeasibilityCheckReport:
    feasibilityCheckResult: 'FEASIBLE'
  lastUpdatedTime: '2023-09-15-14-37-50'
  intentReference: 'RAN_Energy_Saving'
```

Potential deployment scenarios for intent interface

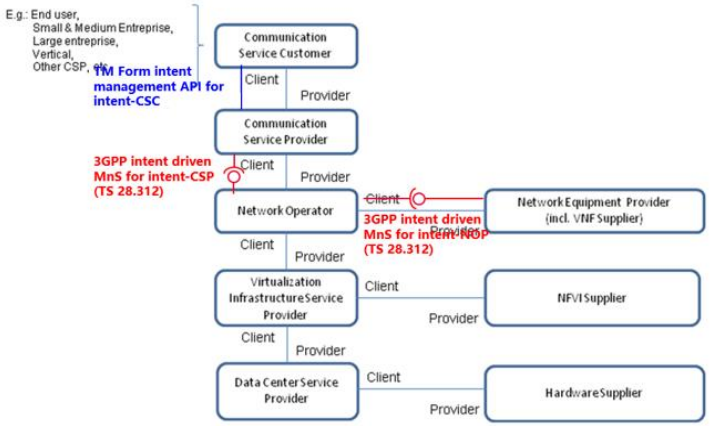
Potential deployment scenario#1



In this deployment scenario, 3GPP intent driven MnS (including Management operation for Intent and generic Information model definition can be applicable for following kinds of standardized reference interfaces for the management of 3GPP network and services:

- Management interactions for Intent-NOP between NOP and NEP;
- Management interactions for Intent-CSP between CSP and NOP;
- Management interactions for Intent-CSC between CSC and CSP.

Potential deployment scenario#2



In this deployment scenario, 3GPP intent driven MnS can be applicable for following kinds of standardized reference interfaces for the management of 3GPP network and services:

- Management interactions for Intent-NOP between NOP and NEP;
- Management interactions for Intent-CSP between CSP and NOP.

The TM Forum intent management API [7] can be applicable for following kinds of standardized reference interfaces for the management of 3GPP network and services:

- Management interactions for Intent-CSC between CSC and CSP.

In this intent interface deployment scenario, 3GPP also provide guidelines for transformation functionality between the TM Forum intent management API for intent-CSC and the 3GPP intent driven MnS for intent-CSP.

Key outcomes from R19 intent driven management SI (TR 28.914)

Main outcomes from R19 IDMS Ph3 SI

◆ New Capabilities:

- ✓ Intent negotiation functionalities, including :
  - ✓ Intent negotiation functionalities in intent pre-evaluation phase (specifically Intent feasibility check and Intent exploration)
  - ✓ Intent negotiation functionalities in Intent fulfilment phase (specially checking for fulfillable outcomes, checking for best possible outcome, recommending fulfillable intent targets and contexts, advises on preferred alternatives)
  - ✓ Methods by which consumers can express the relative value of an intent's expectations to assist the IDMS producer(s) in fulfilling their intents in the most acceptable manner, including Intent Utility Function and satisfaction index.
- ✓ Implicit intent report subscription with customized requirements.
- ✓ Intent handling state management.
- ✓ Intent handling capability enhancement, specifically the capability to provide a description of the supported scenario specific intents.
- ✓ Intent degradation based on expectation preference.
- ✓ Enablers for Intent Fulfilment.

◆ New Scenarios

- ✓ Enhance the RadioServiceExpectation to support the scenario of delivering a radio service in a scheduled time scenario.
- ✓ Enhance the RadioNetworkExpectation to support following scenarios: RAN energy saving scenario, Radio network traffic assurance for scheduled events scenario, Radio network support for UAV pre-flight preparation and Radio Network support MOCN undifferentiated radio service.
- ✓ Introduce communication service expectation for communication service delivering and assurance.
- ✓ Introduce intent expectation for network maintenance.

◆ **Guidelines for using intent generic information model to support new scenario which is not standardized.**

Proposals

- 3GPP is open for collaborating with SDOs on intent driven management based on selected use cases.
- The collaboration shall take 3GPP time plan into account. R19 WI started from 11th 2024 and will be finished in June 2025.

Thank you!